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10/706,902	11/12/2003	Hee Yeop Chae	AMAT/8501/ETCH/DRIE/JB	7748

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EXAMINER

TRAN, BINH X

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 02/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/706,902	<b>Applicant(s)</b> CHAE ET AL.	
	<b>Examiner</b> Binh X. Tran	<b>Art Unit</b> 1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12 November 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-40 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>02-17-2004</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Interpretations*

1. In claims 4, 22 and 40, applicants disclose the flow rate of H<sub>2</sub> "is between about 0 sccm to about 500 sccm". In claims 5, 23 and 40, applicants disclose the flow rate of CF<sub>4</sub> "is between about 0 sccm to about 1000 sccm" (emphasis added). Since applicants discloses the amount of the H<sub>2</sub> and/or CF<sub>4</sub> is zero sccm, therefore the examiner will reserve the right to interpret a zero amount of H<sub>2</sub> and/or CF<sub>4</sub> read on applicants' invention. Respect to claims 11 and 31, applicants discloses that "the bias power is between 0 watts to 1000 watts". As discussed above, the examiner will reserve the right to interpret without bias power read on applicants 0 watts bias power.

### *Claim Objections*

2. Claims 2, 9, 20, and 27 are objected to because of the following informalities:

In claim 2 and 20, the phrase "selected from a group consisting of" (emphasis added) is improper Markush language. The examiner suggests replacing the term "a" with --the--.

In claims 9 and 27, the examiner suggests applicants to spell out what's the abbreviation "TESAC" stand for.

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-2, 4-5, 19-20, 22-23, 28, 30 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al. (US 2004/0132291 A1).

Respect to claim 1, Lee ('291) discloses a method for selectively etching a sacrificial light absorbing material (160) over a dielectric layer (105 or 120) on a substrate, comprising the steps of:

providing a substrate comprising a sacrificial light absorbing material (160) and a dielectric material (105 or 120) to a process chamber (paragraph 0029, 0031, 0038);

supplying to the process chamber a process gas mixture comprising a hydrofluorocarbon ( $C_xH_yF_z$ ), a nitrogen-containing gas, an oxygen-containing gas and an inert gas (Ar) (paragraph 0044);

dissociating and ionizing the process gas (i.e. RIE) the process gas mixture to etch the sacrificial light absorbing material (160) (See paragraph 0044, Fig 10).

Respect to claim 2, Lee ('291) teaches to use zero amount of  $H_2$  (See paragraph 44) and zero amount of  $CF_4$ . Respect to claim 4, as discuss above Lee ('291) teaches to use 0 sccm of  $H_2$ . Since the amount of  $H_2$  equal to zero, the flow rate ratio of hydrogen to oxygen-containing gas must be zero. Respect to claim 5, as discuss above Lee ('291) teaches to use 0 sccm of  $CF_4$ . Since the amount of  $CF_4$  equals to zero, the

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flow rate ratio of fluorine-rich fluorocarbon (i.e. CF<sub>4</sub>) to oxygen-containing gas must be zero.

Respect to independent claim 19, Lee ('291) further teaches that the substrate comprising a photoresist material (185a, See paragraph 0043), a sacrificial light absorbing material (160) and a dielectric material. The limitation of claims 20, 22-23 has been discussed above. Respect to claim 28, Lee ('291) does not explicitly disclose that photoresist is a deep ultraviolet (DUV) photoresist. However, Lee ('291) clearly teaches to use ultraviolet wavelength of 248 nm or 193 nm or less (paragraph 0042). By definition, the term deep ultraviolet is refers to wavelengths below 300 nm (See prior made of record). Thus, the examiner interprets Lee implicitly teaches to use deep ultraviolet photoresist. Respect to claim 30, Lee ('291) teaches the photoresist (185a) is formed atop the sacrificial light absorbing material (160) (See Fig 9-10).

5. Claims 1-2, 4-5, 10-12, 14, 19-20, 22-23, 29-32, 34 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al. (US 2002/0173143 A1).

Respect to claim 1, Lee ('143) discloses a method for selectively etching a sacrificial light absorbing material (314 or 614) over a dielectric layer (306 or 607) on a substrate, comprising the steps of:

providing a substrate comprising a sacrificial light absorbing material (314 or 614) and a dielectric material (306 or 607) to a process chamber (paragraph 0047, 0052, 0038);

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supplying to the process chamber a process gas mixture comprising a hydrofluorocarbon ( $C_xH_yF_z$ ), a nitrogen-containing gas, an oxygen-containing gas and an inert gas (Ar) (paragraph 0054);

dissociating and ionizing the process gas the process gas mixture to etch the sacrificial light absorbing material (See paragraph 0054, 0085, Fig 15).

Respect to claim 2, Lee ('143) teaches to use zero amount of  $H_2$  (See paragraph 85) and zero amount of  $CF_4$ . Respect to claim 4, as discuss above Lee ('143) teaches to use 0 sccm of  $H_2$ . Since the amount of  $H_2$  equal to zero, the flow rate ratio of hydrogen to oxygen-containing gas must be zero. Respect to claim 5, as discuss above Lee ('143) teaches to use 0 sccm of  $CF_4$ . Since the amount of  $CF_4$  equals to zero, the flow rate ratio of fluorine-rich fluorocarbon (i.e.  $CF_4$ ) to oxygen-containing gas must be zero.

Respect to claim 10, Lee teaches the dielectric (306) is SiOC (paragraph 0047, read on "carbon doped oxide"). Lee does not explicitly disclose carbon-doped oxide with 1-50% atomic weight carbon contain. However, the molecular weight of SiOC = atomic weight of Si + atomic weight of O + atomic weight of C =  $28 + 16 + 12 = 56$  base on periodic table. Further, it is known the carbon has atomic weight of 12 (See periodic table). Therefore, the atomic weight percentage of carbon equals to  $12/56 * 100\% = 21.43\%$  (within applicant's range of "1 to 50% atomic weight carbon content).

Respect to independent claim 19, Lee ('143) further teaches that the substrate comprising a photoresist material (316, See paragraph 0053), a sacrificial light absorbing material (314) and a dielectric material (306). The limitation of claims 20, 22-

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23, 29 have been discussed above. Respect to claim 30, Lee ('143) teaches the photoresist (316) is formed atop the sacrificial light absorbing material (314) (See Fig 14-15).

Respect to claims 11 and 31, Lee ('143) teaches not to use the bias power. Therefore the examiner will interpret Lee teaches to use the bias power at 0 Watt (within applicant's range of 0-1000 Watts). Respect to claims 12 and 32, Lee ('143) teaches the source power is about 1000-5000 watts (paragraph 0085, read on applicant's range of "50 to 5000 Watts"). Respect to claims 14 and 34, Lee ('143) discloses the process pressure is between 5-50 mtorr (paragraph 0085, within applicant's range of 1 mtorr to 1 Torr).

### ***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 9, 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee ('143) in view of Kennedy et al. (US 6,268,457).

Respect to claim 9 and 27, Lee fails to disclose the sacrificial light absorbing material is TESAC dyed methylsiloxane polymer. However, Lee clearly teaches the sacrificial light absorbing material is an anti-reflective material formed by a spin-coating process. Kennedy teaches to use dyed 9-anthracene carboxy-methyl triethoxysilane (aka TESAC) methylsiloxane polymer (col. 2 lines 20-40) because this material strongly absorbing deep ultraviolet. It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Lee ('143) in view of Kennedy by using TESAC dyed methylsiloxane polymer for antireflective because this material strongly absorbing deep ultraviolet.

9. Claims 3, 6-8, 13, 15-18, 21, 24-26, 33, 35-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee ('143) in view of Zhu et al. (US 6,962,879).

Respect to claims 3, 21, Lee teaches to use hydrofluorocarbon gas, oxygen gas to etch the antireflective layer (or light absorbing material). However, Lee fails to disclose the hydrofluorocarbon gas is  $\text{CH}_3\text{F}$  as well as the specific flow rate of each gas. In a method for etching anti-reflective layer, Zhu teaches to use  $\text{CH}_3\text{F}$  and oxygen for etching anti-reflective layer (col. 7). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Lee in view of Dalton by using  $\text{CH}_3\text{F}$  as fluorohydrocarbon gas because equivalent and substitution of one for the other would



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produce an expected result. Zhu further teaches to the flow rate of  $\text{CH}_3\text{F}$  equals to 25 sccm (within applicant's range of 5-500 sccm) and the flow rate of oxygen equals to 20 sccm (col. 7 lines 64). Base on this information, the flow ratio of  $\text{CH}_3\text{F}$  gas to oxygen gas equals to  $25/20 = 1.25$  (within applicants range of 1 to 20).

Respect to claims 3, 6-8, 13, 15-18, 21, 24-26, 33, 35-40 Lee fails to disclose the specific flow rate, flow rate ratio, electrode temperature, etch selectivity, etch rate for the etching process. However, Lee ('143) clearly teaches to etch the light absorbing material using the same etchant composition with applicant's invention. Zhu teaches the specific flow rate, flow rata ratio, electrode temperature etch selectivity, etch rate are result effective variables (col. 7-8, Table 1-2). The result effective variables are commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment in order to obtain optimal flow rate, flow rate ratio, and/or electrode temperature as an expected result.

Respect to claims 7-8, 25-26, Zhu teaches to use 20 sccm  $\text{O}_2$ , and 200 sccm Argon (inert) (col. 7 line 64). Base on this information, the flow ration of inert gas to oxygen equal to  $200/20 = 10$  sccm (within applicant's range of 1 to 30). Respect to claims 13 and 33, Zhu discloses the bottom electrode is  $40^\circ\text{C}$  (col. 7 lines 60, read on "the cathode temperature is maintained between  $-20^\circ\text{C}$  to  $80^\circ\text{C}$ ).

Respect to claim 40, Lee ('143) teaches to use 0 sccm  $\text{H}_2$  (See paragraph 85) and 0 sccm  $\text{CF}_4$ . Zhu also teaches to use 0 sccm  $\text{H}_2$  and 0 sccm  $\text{CF}_4$  (col. 7 lines 55-

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67). Since the amount of  $H_2$  equal to zero, the flow rate ratio of hydrogen to oxygen-containing gas must be zero. Since the amount of  $CF_4$  equals to zero, the flow rate ratio of fluorine-rich fluorocarbon (i.e.  $CF_4$ ) to oxygen-containing gas must be zero.

### ***Conclusion***

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ultraviolet from Wikipedia, [http://en.wikipedia.org/wiki/Deep\\_ultraviolet](http://en.wikipedia.org/wiki/Deep_ultraviolet) discloses that "deep ultraviolet or DUV" refers to wavelengths below 300 nm.

Lee US 2002/0168849 A1 discloses that SiOC is a carbon doped silicon oxide (paragraph 012).

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should

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you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh Tran

Binh X. Tran